Integration of Energy and Water Cycle Research Products in a Global Land Surface Modeling and Assimilation System

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Project Abstract

Significant advancement of energy and water cycle science will demand the synthesis of data products from multiple sources in order to generate a physically consistent and realistic, global representation of terrestrial hydrospheric processes. Numerous streams of satellite observations are now providing the raw materials to enhance our understanding of the Earth system. At the same time, powerful yet economic computers and scientific innovations are enabling global scale models to simulate physical processes more realistically and at higher resolutions than ever before. The NASA Energy- and Water Cycle Sponsored Research (NEWS) program will support the development of both global, observation based land data products and computational capabilities for merging these observations with our knowledge of physical processes as embodied in numerical models. We propose that these products and capabilities be integrated within a robust land surface modeling and assimilation infrastructure, in particular one which has already been developed, tested, and made available to the scientific community over the past four years, led by a team of researchers at NASA Goddard Space Flight Center (GSFC).

The heart of this infrastructure is a software package known as the Land Information System (LIS), which is able to drive multiple, sophisticated land surface models (LSMs) on global to local scales and multiple resolutions ranging from 1° to down 1 km and finer. LIS has an object-oriented software engineering design, making it the ideal tool for integrating the new generation of data assimilation algorithms and space based observational products that NEWS will engender. Furthermore, LIS adheres to Earth System Modeling Framework and Assistance for Land Modeling Activities standards. LIS was a high performance computing initiative based on the Global Land Data Assimilation System (GLDAS) heritage, which in turn had roots in the multi-institution North American Land Data Assimilation Systems project. GLDAS successfully demonstrated that realistic land surface state and flux fields could be produced by combining observation based products within sophisticated LSMs. Several data assimilation algorithms and advanced modeling capabilities were already developed and tested in conjunction with that project. The massive GLDAS archive of land surface and meteorological data is still being maintained and augmented despite the fact that funding has ended for that project. This data archive will provide a foundation for the proposed endeavor.

Our hypothesis is that global land surface energy and water cycles cannot be skillfully represented and described without a comprehensive approach, which integrates the best observation based hydrometeorological products as data for forcing, constraining, and evaluating sophisticated LSMs. Therefore we will incorporate mature data assimilation techniques, datasets, and other advancements promoted by NEWS into the LIS global land surface modeling and assimilation system, with the goal of assessing their impact on the production of high resolution fields of land surface states and fluxes.